LECTURE 7

Data Analysis I: FTools

What is FTools?

- Suite of utility programs for
  - manipulating FITS format files
  - analyzing data in FITS files
  - presenting data in FITS files
- Most tools are command-line driven
- Some tools have GUIs

- Distributed by NASA's High Energy Astrophysics Science Archive Research Centre (HEASARC)
- FTools is a free package.

- unix-based
- runs under Windows and Mac OS X

- Source code written in Fortran or C
- Scripts are written in Perl 5
- GUI tools are written in Tcl/Tk
- Standardized interface
- I/O via FITS files or ASCII files

- Individual FTools perform single tasks
- Chain FTools together to perform complex tasks

Missions Supported by FTools
- *ASCA*
- *Einstein*
- *EXOSAT*
- *CGRO*
- *HEAO-1*
- *INTEGRAL*
- *OSO-8*
- *ROSAT*
- *Suzaku*
- *Swift*
- *Vela*
- *XTE*

XSPEC

- *X*-ray spectral fitting program
- Command line driven
- Interactive
- Plotting functions

- Works for *any* data

- Fits a model spectrum to observed spectral data

$$C(I) = \int f(E) R(I, E) dE$$

where
$C(I)$ = observed count rate in channel *I*
$f(E)$ = true spectrum of the source
$R(I,E)$ = instrumental response function

Response is proportional to the probability that an incoming photon with energy *E* will be detected in channel *I*.

Solve for *f(E)* by inverting the integral?

Inverting the integral is not a good solution. Inversions are sensitive to noise in the data, and tend to have non-unique solutions.

Forward Modelling (the XSPEC approach)
- Assume a model
- Convolve it with the response function
- Fit to the observed data.
- Adjust model parameters
- Minimize goodness of fit

data and folded model
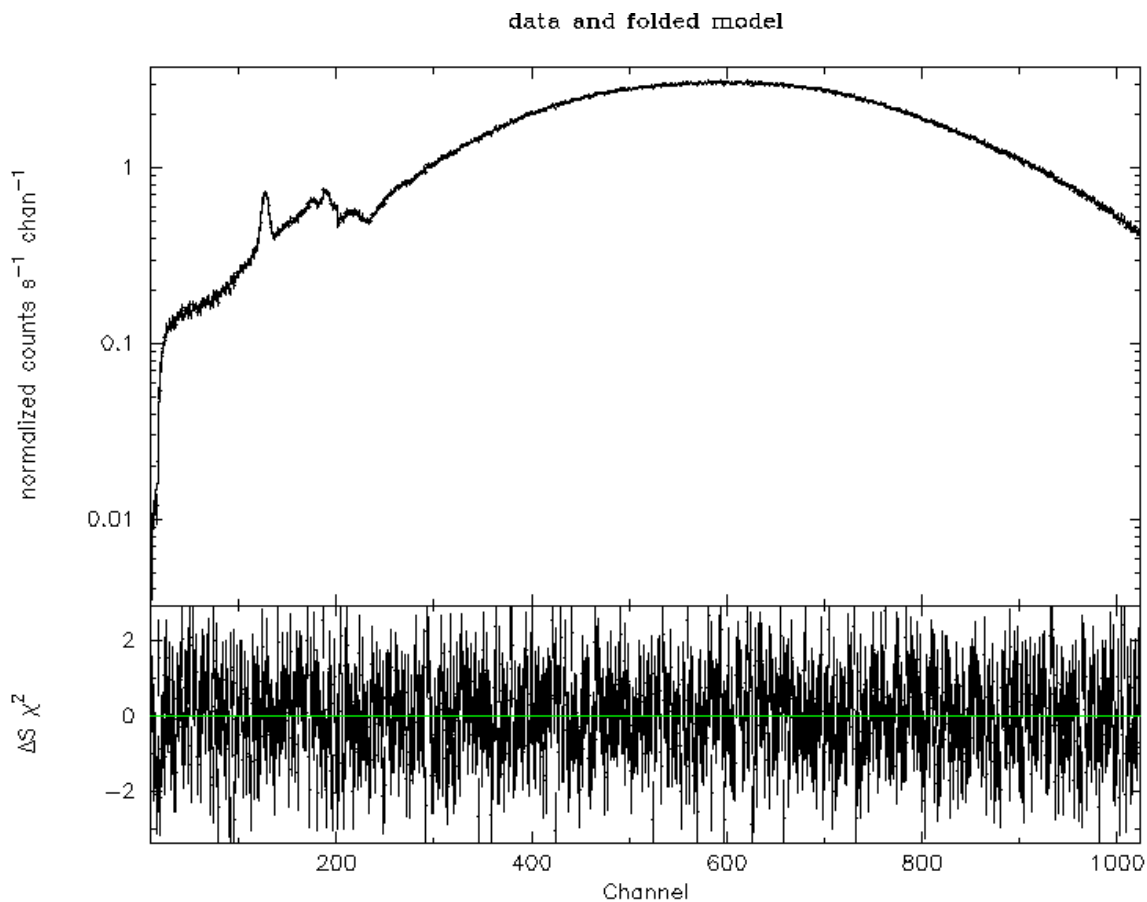
XImage

- *X*-ray image display package
- Command line driven
- Interactive
- Source detection
- Measure fluxes in source
- Plot results

- Similarities to DS9
- Designed for *X*-ray data
    - Assumes low backgrounds
- Not always suitable for optical images
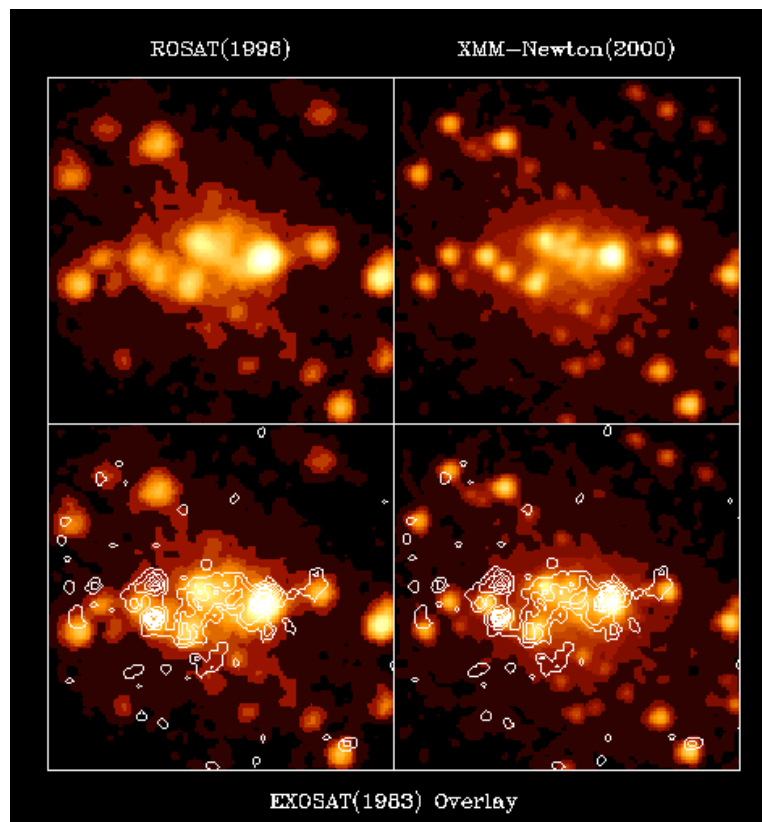
Xronos

- General timing analysis package
- Command line driven
- Interactive
- Does plotting

- Uses
  - Light curves
  - Finding periodicities
  - Power spectra

- Requires time-tagged photons
- Designed for *X*-ray astronomy, but will work at any wavelength
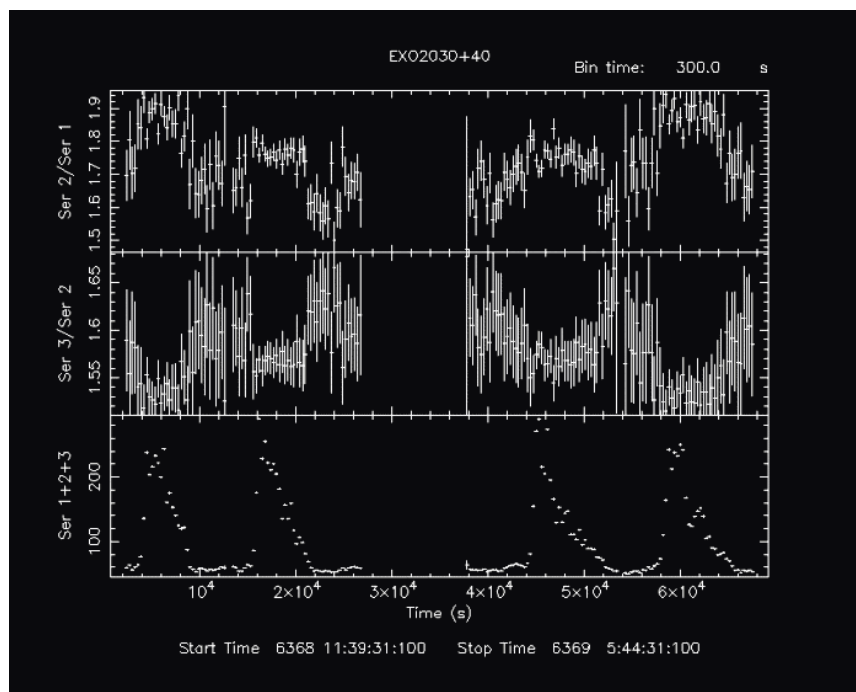
Getting Help

- Help files for every FTool
- Help files for general concepts
    - Filenames
    - Calculator functions
- Help files for mission-specific tools

The help command:

➤ fhelp ftools

➤ fhelp *taskname*

Running an FTool

Type the name of the FTool on the command line

Two ways to enter parameters

1. Let the tool prompt you
   - ftlist
     Input file name [input.fits] source.cat
     Print options: H C K I T [T]

2. Enter parameters on the command line
   - ftlist source.cat T columns=MAG,MAG_ERR

To see all the parameters for a task

- plist *taskname*

Hidden parameters (those enclosed in parentheses) *must* be entered on the command line in the form "parameter=value"